

QUARKS

The u -, d -, and s -quark masses are estimates of so-called “current-quark masses,” in a mass-independent subtraction scheme such as \overline{MS} at a scale $\mu \approx 2$ GeV. The c - and b -quark masses are estimated from charmonium, bottomonium, D , and B masses. They are the “running” masses in the \overline{MS} scheme. These can be different from the heavy quark masses obtained in potential models.

u

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

Mass $m = 1.5$ to 5 MeV [a] Charge = $\frac{2}{3} e$ $I_z = +\frac{1}{2}$
 $m_u/m_d = 0.20$ to 0.70

d

$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+)$$

Mass $m = 3$ to 9 MeV [a] Charge = $-\frac{1}{3} e$ $I_z = -\frac{1}{2}$
 $m_s/m_d = 17$ to 25
 $\bar{m} = (m_u + m_d)/2 = 2$ to 6 MeV

s

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass $m = 60$ to 170 MeV [a] Charge = $-\frac{1}{3} e$ Strangeness = -1
 $(m_s - (m_u + m_d)/2)/(m_d - m_u) = 34$ to 51

c

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass $m = 1.1$ to 1.4 GeV Charge = $\frac{2}{3} e$ Charm = $+1$

b

$$I(J^P) = 0(\frac{1}{2}^+)$$

Mass $m = 4.1$ to 4.4 GeV Charge = $-\frac{1}{3} e$ Bottom = -1

t

$$I(J^P) = 0(\frac{1}{2}^+)$$

$$\text{Charge} = \frac{2}{3} e \quad \text{Top} = +1$$

Mass $m = 173.8 \pm 5.2$ GeV (direct observation of top events)

Mass $m = 170 \pm 7 (+14)$ GeV (Standard Model electroweak fit, assuming $M_H = M_Z$. Number in parentheses is shift from changing M_H to 300 GeV.)

b' (4th Generation) Quark, Searches for

Mass $m > 128$ GeV, CL = 95% ($p\bar{p}$, charged current decays)

Mass $m > 46.0$ GeV, CL = 95% (e^+e^- , all decays)

Free Quark Searches

All searches since 1977 have had negative results.

NOTES

[a] The ratios m_u/m_d and m_s/m_d are extracted from pion and kaon masses using chiral symmetry. The estimates of u and d masses are not without controversy and remain under active investigation. Within the literature there are even suggestions that the u quark could be essentially massless. The s -quark mass is estimated from SU(3) splittings in hadron masses.